

(12) UK Patent Application (19) GB (11) 2 192 300 (13) A

(43) Application published 6 Jan 1988

(21) Application No 8712127

(22) Date of filing 22 May 1987

(30) Priority data

(31) 8607303 (32) 22 May 1986 (33) FR

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(51) INT CL⁴
A01M 29/02

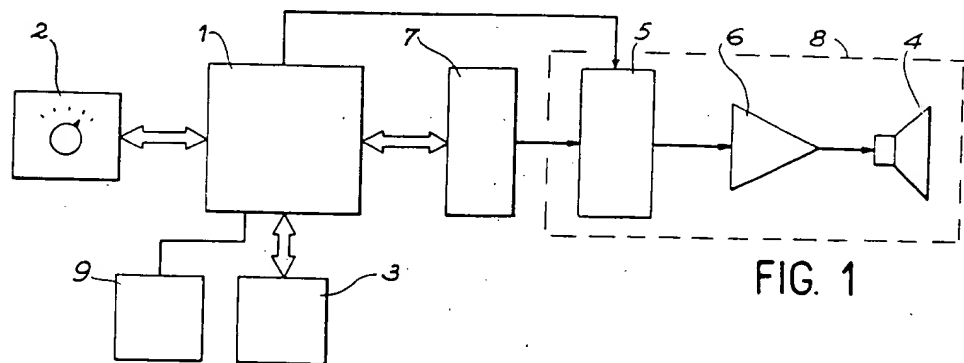
(52) Domestic classification (Edition J)
G5J 2A 5S ECB EGK
U1S 1015 1181 1185 1274 1290 1839 G5J

(56) Documents cited
GB A 2090693 US 4338844
GB A 2013945 US 4248121
EP A1 0042019 US 4064507

(58) Field of search
G5J
Selected US specifications from IPC sub-classes A01M
G08B G10H G10K

(54) Improvements in or relating to synthesis of animal cries

(57) An animal cry of alarm, distress or repulsion is synthesised by performing an harmonic analysis of the frequencies of such sounds and then reproducing such sounds synthetically, by supplying an electronically synthesised signal to an electro-acoustic transducer (4). The signal is synthesised by generating a rectangular signal, with variable frequencies and mark/space ratios, according to the frequencies determined by the analysis, and setting for each period of the rectangular signal the mark/space ratio of the signal, as a function of only the harmonics which are required to be preserved in the frequencies of the synthetic sounds supplied by the electro-acoustic transducer.



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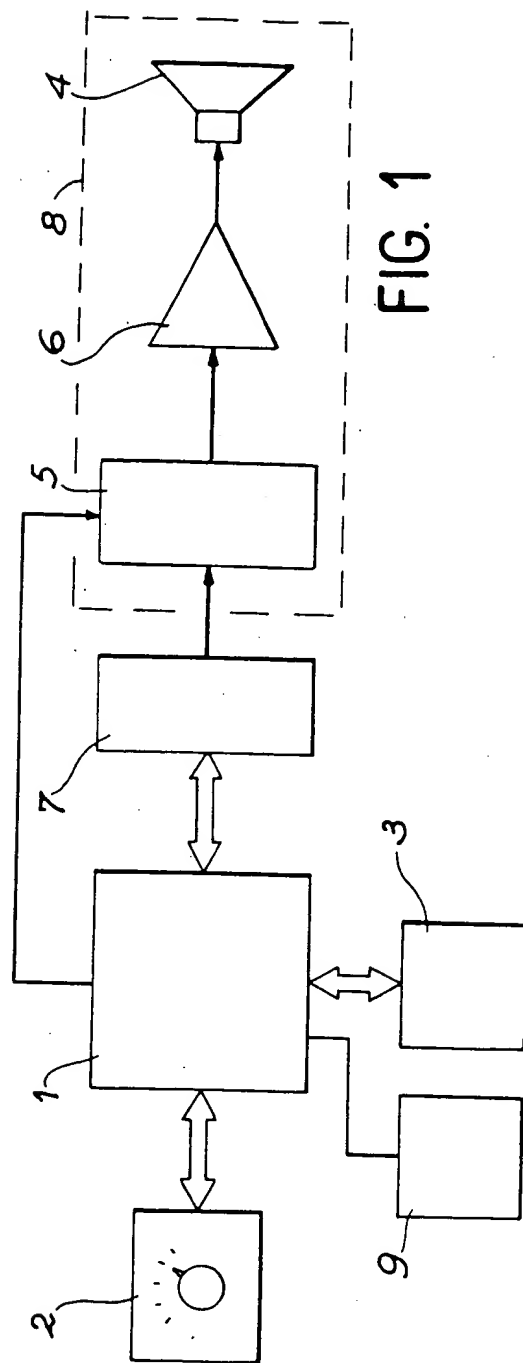


FIG. 1

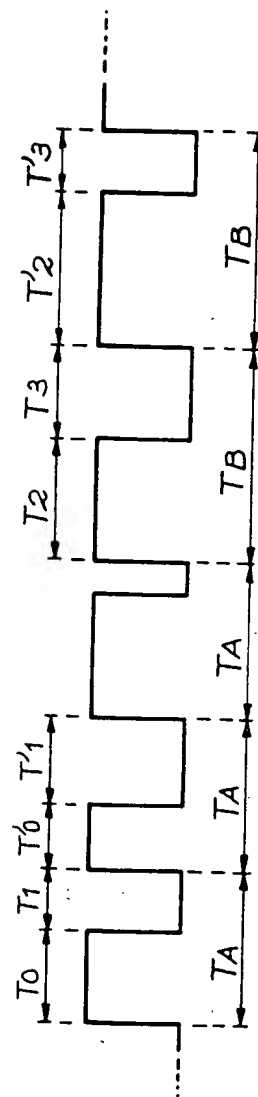


FIG. 2

SPECIFICATION

Improvements in or relating to synthesis of animal cries

- 5 The present invention relates to a synthesis of sounds corresponding to animal cries, such as cries of distress intended to frighten certain animals (mammals and birds) which one wishes to keep away from a particular place.
- 10 It is known to be necessary, particularly in areas where there is air traffic or in agricultural areas, to remove certain birds for example, which can either damage aircraft by moving around or near airports, or cause destruction to agricultural crops.
- 15 Different processes are known for reproducing sounds corresponding to animal cries, for example cries of distress or alarm for birds, or mammals, for the purpose of frightening animals away. The most common process consists of recording on magnetic
- 20 tape of a tape recorder cries of distress of the particular species of animal which one wishes to frighten. It should moreover be noted that cries of distress of one species can frighten not only that species, but also certain other species.
- 25 According to this process, all that is required is for the tape to be played using a tape recorder to reproduce the sounds (cries of distress or alarm) recorded on this tape. The tape recorder is of course placed close to the area where the species of animal
- 30 to be frightened congregates.
This recording process and process for sound reproduction, by magnetic tape, is unreliable, primarily for mechanical reasons.
A process is also known which allows animal cries
- 35 to be reproduced synthetically. This process consists first of all in carrying out an harmonic analysis of the sounds corresponding to the cries of distress of animals of the species in question. The process then consists in reproducing the sounds
- 40 corresponding to these cries of distress, synthetically, by applying an electrically synthesised signal to an electro-acoustic device.
The electrical synthesised signal has a frequency which is variable according to frequencies
- 45 predetermined by analysis and reproduced as faithfully as possible; this process tends to reproduce not only the fundamental frequencies which correspond to the sounds analysed, but also all the corresponding harmonic frequencies.
- 50 From the analysis of natural sounds, it is known that sounds of distress or alarm, as well as repulsive sounds having an effect on mammals and birds, have a highly characteristic structure. Such sounds always comprise equidistant frequencies to which
- 55 frequency modulation is applied. Detailed examination of the sound structure shows that this equidistance is obtained in the most diverse ways depending on the species of animal. Sounds are thus encountered which are true harmonic series
- 60 (rarely), others comprise beats from several frequencies. In the known processes, efforts are made to use all the parameters occurring in the composition of natural sounds.
This type of process requires the use of highly
- 65 efficient and powerful means for processing data, associated with very high capacity memories, since the sounds are reproduced as faithfully as possible using all the parameters arising from the prior harmonic analysis.
- 70 According to one aspect of the invention, there is provided an apparatus for producing a signal for simulating an animal distress, alarm or repulsion call, comprising means for generating a rectangular wave signal whose repetition rate substantially
- 75 corresponds to the fundamental frequency of a natural distress, alarm or repulsion call and whose mark/space ratio is varied so as to substantially reproduce at least some of the harmonic components of the natural call.
- 80 According to another aspect of the invention, there is provided a method of synthesising sounds corresponding to cries of distress, alarm or repulsion of animals, comprising performing an harmonic analysis of the frequencies of such a
- 85 sound and reproducing such a sound synthetically by supplying an electronically synthesis signal to an electro-acoustic transducer, the electronically synthesised signal being synthesised by generating a rectangular signal, with variable cyclical
- 90 frequencies and ratios, according to the frequencies determined by the analysis, and setting for each period of the rectangular signal the mark/space ratio of the signal as a function of only the harmonics which are required to be preserved in the
- 95 frequencies of synthetic sounds supplied by the electro-acoustic transducer.
It is thus possible to provide a simple and inexpensive process for synthesising sounds corresponding to cries of distress, alarm or
- 100 repulsion, of animals which does not make use of prior recording, during which cries of different species are recorded and reproduced unreliably (in the case of processes using a tape recorder); and which does not require powerful and costly means
- 105 for data-processing, reproducing as faithfully as possible the sounds analysed by using all parameters determined during prior analysis. Further, the use of parameters defined by prior analysis of natural sounds is not required.
- 110 Only some parameters are retained. Their number is so restricted that they can be selected manually. The use of a process for automatic digitalisation of the parameters is not necessary. All that is required to reproduce cries of distress, alarm or repulsion of
- 115 animals is as follows:
simplification of the equidistant series of frequencies existing in natural sounds;
simplification of the frequency modulation;
reduction of the number of relative levels of the
- 120 frequencies comprising the acoustic spectrum: and phase relations may be ignored.
Consequently, considerable savings in memory may be made over the known processes using powerful data processing means.
- 125 Experimental research has shown that successive algorithm simplifications could be used for the synthetic reproduction of cries of distress, alarm or repulsion by animals.
The repulsive cries of distress or alarm cause
- 130 frequency modulation applied to a carrier

frequency. The characteristics of this modulation and the carrier wave must be reproduced. It is however possible to simplify this process.

In respect of the carrier wave, instead of

- 5 generating individually each frequency comprising the spectrum, a complex sound is generated, ignoring phase relations. This sound should comprise equidistant frequencies. The equidistance intervals should be those found in natural sounds.
- 10 As far as the relative levels of the components of the spectrum are concerned, approximations are permissible.

- The frequency modulation is applied to the simplified carrier wave described above. It is
- 15 necessary to be positioned within the norms of the sounds of each species, but only reproducing the essential characteristics. With the above simplifications, a technique using the crossover of a rectangular signal is sufficient to reproduce such
- 20 sounds synthetically. Use is made of a rectangular synthesis signal having a mark/space ratio which is different from 1, in order to comprise the carrier frequency. By varying this ratio, it is possible to obtain an approximation of the carrier frequencies
- 25 which respects the relative levels of the harmonics of natural sounds. Undesirable frequencies, if any, can be eliminated by filtering. The frequency modulation is independent of the mark/space ratio and is obtained by changing the duration of the consecutive periods of the synthesised signals.
- 30 Despite these simplifications, the synthesised signals thus obtained are fully effective.

- The invention will be further described, by way of example, with reference to the accompanying
- 35 drawings, in which:

- Fig. 1 shows diagrammatically an apparatus for reproducing synthetically cries of distress of animals in accordance with a preferred embodiment allowing the process of the invention; and
- 40 Fig. 2 shows the waveforms of signals supplied by the apparatus of Figure 1 to an electro-acoustic transducer.

- Figure 1 shows diagrammatically a processing unit for synthesising sound comprising a
- 45 microprocessor 1 to which are connected, in a known manner, a read only memory 2 and a read-write or random access memory 3 (working memory of the microprocessor). The read only memory 2 contains the programs for controlling the
- 50 processing done by the microprocessor 1 on the parameters relating to the sound synthesis to be carried out. These parameters have values which are determined by the analysis of the sounds to be reproduced and they make it possible to reproduce
- 55 synthetically the sounds corresponding to cries of distress, alarm or repulsion of animals, by applying an electrical synthesised signal to an electro-acoustic device 8. The electro-acoustic device comprises a loudspeaker 4 which is connected to
- 60 the output of an amplifier 6 whose input is connected to the output of a filter 5 (permitting the elimination of certain frequencies which are not required to be reproduced). The filter 5 receives the synthesised signal from the output of a logic device
- 65 7 itself connected to the microprocessor 1. The

synthesised signal is rectangular with a variable frequency and a cyclical or mark/space ratio which is set according to parameters recorded in the read-write memory 3. The synthesised signal is provided

- 70 by the logic unit 7, controlled by the microprocessor 1, and is supplied to the amplifier 6. The logic unit 7 may comprise, for example, bistable trigger circuit the conduction or on period of which is set by the microprocessor as a function of the parameters described above and pre-recorded in the read-write
- 75 memory 3. The frequencies of the synthesised signal supplied by the logic unit 7 are also set by the microprocessor as a function of the parameters pre-recorded in the read-write memory 3. The filter 5 can
- 80 be programmable and controlled by the microprocessor 1, and allows the elimination of frequencies which are not required to be reproduced.

The apparatus also comprise manual means 9

- 85 connected to the microprocessor 1 for selecting, depending on the species of animal whose cries are to be reproduced the parameters pre-recorded in the memory and corresponding to that species.

Figure 2 shows a graph against time of the signals

- 90 supplied by the logic unit 7 controlled by the microprocessor 1 to the loudspeaker 4 by means of the amplifier 6 and the filter 5.

The variable frequency synthesised signal is a rectangular signal. The variable frequency of this

- 95 signal depends on the parameters selected by analysis, as set out above. For each period of the rectangular signal the mark/space ratio of the signal is set as a function of the harmonics which are required to be preserved in the synthetic sounds provided by the loudspeaker 4. The synthesised
- 100 signal shown as an example in this figure is a signal which for a certain duration h_1 is a frequency $F_A = 1/T_A$ of period T_A , and which for another period has a frequency $F_B = 1/T_B$, of period T_B , etc. For each frequency and for each period, the cyclical ratio of this signal is set according to the parameters
- 105 recorded in the read-write memory 3. For example, for frequency F_A during the first period T_A , the mark/space ratio is equal to T_1/T_0 whereas during the next
- 110 period T_A , the mark/space ratio is equal to T'_1/T'_0 . Similarly, for frequency F_B and for the first period T_B , the mark/space ratio of the signal is equal to T_2/T_0 and, for the second period T_B , the mark/space ratio is equal to T'_2/T'_0 The mark/space ratio provides
- 115 in the synthetic sounds supplied by the electro-acoustic device only certain harmonics of the frequencies of sounds corresponding to particular cries of distress, alarm and repulsion by animals. Experience has shown that, contrary to the
- 120 previously used techniques it is not necessary to reproduce all the frequencies of the sounds analysed, but only some of the harmonics of frequencies of these sounds. The application of this process shows in effect that the majority of animals, and more particularly birds, are effectively
- 125 frightened by synthetic reproduction of sounds in which there are present only certain harmonics of frequencies of sounds corresponding to cries of distress. The fear is much greater than when sounds
- 130 corresponding to cries of distress are reproduced in

ised signal is rectangular with a variable cy and a cyclical or mark/space ratio which is rding to parameters recorded in the read-memory 3. The synthesised signal is provided igit unit 7, controlled by the microprocessor supplied to the amplifier 6. The logic unit 7 rprise, for example, bistable trigger circuit uction or on period of which is set by the icroprocessor as a function of the parameters 1 above and pre-recorded in the read-write 3. The frequencies of the synthesised plied by the logic unit 7 are also set by the icroprocessor as a function of the parameters pre-in the read-write memory 3. The filter 5 can mable and controlled by the icroprocessor 1, and allows the elimination of s which are not required to be d.

aratus also comprise manual means 9 to the microprocessor 1 for selecting, on the species of animal whose cries are duced the parameters pre-recorded in y and corresponding to that species. shows a graph against time of the signals / the logic unit 7 controlled by the icroprocessor 1 to the loudspeaker 4 by means of r 6 and the filter 5.

ble frequency synthesised signal is a signal. The variable frequency of this nds on the parameters selected by set out above. For each period of the signal the mark/space ratio of the signal nction of the harmonics which are e preserved in the synthetic sounds the loudspeaker 4. The synthesised r as an example in this figure is a signal ertain duration t_0 has a frequency $F_A = 1/T_A$, and which for another period has a $= 1/T_A$, of period T_B , etc. For each d for each period, the cyclical ratio of set according to the parameters e read-write memory 3. For example, F_A during the first period T_A , the mark/ equal to T_1/T_0 whereas during the next mark/space ratio is equal to T'_1/T'_0 . frequency F_B and for the first period T_B , e ratio of the signal is equal to T_3/T_2 cond period T_B , the mark/space ratio $T'_2 \dots$. The mark/space ratio provides sounds supplied by the electro- only certain harmonics of the sounds corresponding to particular , alarm and repulsion by animals. shown that, contrary to the techniques it is not necessary to e frequencies of the sounds ly some of the harmonics of ese sounds. The application of this n effect that the majority of animals, arly birds, are effectively nthetic reproduction of sounds in resent only certain harmonics of unds corresponding to cries of is much greater than when sounds cries of distress are reproduced in

full, as for example in the known processes of tape reproduction or synthetic reproduction.

Thus, cries of alarm or distress of birds or mammals can be reproduced, sounds of a repulsive character can be produced, and simple sounds such as birdsong can be synthesised.

CLAIMS

1. An apparatus for producing a signal for
- 10 simulating an animal distress, alarm or repulsion call, comprising means for generating a rectangular wave signal whose repetition rate substantially corresponds to the fundamental frequency of aa natural distress, alarm or repulsion call and whose
- 15 mark/space ratio is varied so as to substantially reproduce at least some of the harmonic components of the natural call.
2. An apparatus for producing a signal for
- 20 simulating an animal distress alarm or repulsion call, substantially as hereinbefore described with reference to and as illustrated in the accompanying

drawings.

3. A method for synthesising sounds corresponding to cries of distress, alarm or repulsion of animals, comprising performing an harmonic analysis of the frequencies of such a sound, and reproducing such a sound synthetically by supplying an electronically synthesised signal to an electro-acoustic transducer, the electronically
- 25 synthesised signal being synthesised by generating a rectangular signal, with variable cyclical frequencies and ratios, according to the frequencies determined by the analysis, and setting for each period of the rectangular signal the mark/space ratio
- 30 of the signal as a function of only the harmonics which are required to be preserved in the frequencies of synthetic sounds supplied by the electro-acoustic transducer.
4. A method of synthesising a distress, alarm or
- 40 repulsion cry of an animal, substantially as hereinbefore described with reference to the accompanying drawings.